On the Predictive Effect of Multidimensional Importance-Weighted Quality of Life Scores on Overall Subjective Well-Being

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Abstract This study aimed to examine the effectiveness of importance weighting in predicting outcome variables in a hierarchical and multidimensional measurement context. A total of 146 undergraduate students (female = 76; mean age = 20.25) from two universities in Taiwan and China participated in this study. They evaluated their quality of life on 22 facets from the WHOQOL-BREF scale, which covers four domains (i.e., physical health, psychological health, social relationships, and environmental health). They were also asked to rate the importance of these 22 facets and items for three general subjective well-being indices, including overall quality of life, general health, and life satisfaction. A multiplicative formula was used to create importance-weighted scores for each facet, and four domain scores were obtained by averaging facet scores under specific domains. Results of regression analysis revealed that after applying the weighting procedure, the four domain scores did not account for more variances in the three indices for overall subjective well-being, and predictive effects of the four domain scores became less differential. Our findings suggest that importance weighting did not have its expected benefits but instead may negatively impact the predictive effects.

Keywords Weighting · Importance · Quality of life · Subjective well-being

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1 Introduction

Quality of life (QOL) can be broadly defined as an individual's perception of or feelings toward circumstances of important life facets (Wu 2009). According to this perspective, identification of important life facets for an individual is a crucial step in assessing one's QOL. However, not all QOL instruments provide a chance for an individual to nominate the life facets that are utilized to qualify his/her QOL (see Dijkers 2003, for a review), because most QOL instruments were developed to assess QOL among different groups or general populations for social indicators or resource allocation; therefore, they include the same facets for a generic purpose. As such, one strategy to reflect personalized importance of life domains in QOL assessment is to use an importance-weighting procedure. Specifically, based on the idea that important life facets have more influence on individuals' overall QOL than less important facets have (see Hsieh 2012a), several researchers have suggested that an individual's QOL score can be operationalized as the sum of importance-weighted scores in various specific life facets (e.g., Cummins 1997; Ferrans and Powers 1985; Frisch 1992; Hsieh 2003, 2004; McGrath and Bedi 2004; Oliver et al. 1995).

The utility of an importance-weighing procedure has been examined in past studies. Except for a few studies (Hsieh 2012b), most empirical evidence suggests that an importance-weighted score is not better than a unweighted score at predicting outcome variables (e.g., Hsieh 2003; Russell et al. 2006; Trauer and Mackinnon 2001; Wu 2008a; Wu et al. 2009a; Wu and Yao 2006c). In a series of studies based on Locke's range-of-affect hypothesis, Wu and his colleagues (Wu 2008b; Wu and Yao 2006b, 2007b) suggest that there is no psychological basis for importance weighting because an individual has considered the importance of a life facet when evaluating that life facet. Hence, based on the existing literature, importance weighting, especially for QOL evaluation, is seemingly unnecessary (see Russell and Hubley 2005; Wu 2009, for a review).

Nevertheless, past studies on the examinations of the predictive benefit of importance weighting, especially in the QOL research, are restricted to specific research contexts. In brief, most past studies only compared the performance of unweighted scores and importance-weighted scores at the facet level in predicting the same outcome variables (e.g., Wu and Yao 2006b, c) or compared the performance of a unweighted total score and a importance-weighted total score in predicting the same outcome variables (e.g., Hsieh 2003; Russell et al. 2006). However, these two research contexts ignore the nature of the hierarchical and multidimensional structure of QOL measurements. Specifically, more and more QOL measurements have a hierarchical and multidimensional structure by including various facets at the item level that belong to a few domains at a higher level. These measurements then use multiple higher-order domain scores, rather than specific facet scores or a total score, to represent an individual's QOL scores (e.g., Frisch 1992; Kreitler and Kreitler 2006; The WHOQOL Group 1998; Wiggins et al. 2008). As such, examining importance-weighting procedures at the facet score level or at the total score level will not help to gauge whether importance-weighting procedures are useful in a hierarchical and multidimensional measurement context. To date, the performance of importance weighting in this hierarchical and multidimensional context is still unknown.

Hsieh (2011) has indirectly addressed this issue by extending Wu and his colleagues' (Wu 2008b; Wu and Yao 2006b, 2007b) work into multidimensional contexts and by including various facet scores, importance scores, and their product term in a regression model to show that having all multiplicative terms across facets in a model can help to account for more variances of outcome variables. However, his approach does not correspond to the context we mentioned here, because in those hierarchical and

multidimensional measurements, only a few domain scores will be used in practice without also using multiplicative terms across facets. Therefore, for practical purposes, we aim to examine the utility of an importance-weighting procedure with a hierarchical and multi-dimensional measurement.

Examining the performance of importance weighting in this hierarchical and multidimensional measurement context also provides additional information to evaluate the effectiveness of importance weighting. First, in a multidimensional context, we can evaluate the joint predictive effects of several importance-weighted domain scores in predicting outcome variables. If an importance-weighted score captures more individualized meaning of QOL, it should account for more variances in an overall QOL evaluation than the unweighted scores do. When we apply this idea to a multidimensional measurement context, we would expect that multidimensional importance-weighted domain scores together will explain more variances in an overall QOL evaluation than their unweighted scores will. This hypothesis can be tested using regression analysis to see if the R^2 using importance-weighted scores as predictors is higher than the R^2 using unweighted scores as predictors.

Second, in a multidimensional context, we can evaluate not only the amount of explained variance but also whether domains having strong predictive effects on an overall QOL evaluation will be stronger than domains having weak predictive effects after applying an importance-weighting procedure. In other words, if importance-weighted scores capture a more individualized meaning of QOL, we would expect that the predictive pattern of importance-weighted scores will be sharper than that of unweighted scores. In general, we expect that an importance-weighting procedure should bring benefits by increasing explained variances of outcome variables and should strengthen the predictive pattern among several domain scores in predicting outcome variables.

In order to test these two aspects, we used items from the WHOQOL instrument (The WHOQOL Group 1998), a multidimensional QOL measurement, and three indices of overall subjective well-being (overall QOL, general health, and overall life satisfaction) to examine the performance of importance weighting. We use the indices of overall subjective well-being as outcome variables because of three reasons. First, the idea of importance weighting in QOL literature is to capture an individual's overall subjective well-being when an instrument of domain-specific QOL was used. Thus, measures of overall subjective well-being are the best criteria to evaluate the performance of importance weighting. Second, previous findings have supported the distinction between a domain-specific measure of QOL and an overall measure of subjective well-being (e.g., Wu and Yao 2007a, b). As such, although the outcome measures seem to assess the same latent construct as the WHOQOL-BREF scale, they do convey different information in their assessment, which thus provides empirical evidence to use overall measures of subjective well-being as outcome variables. Third, the WHOQOL-BREF scale contains various aspects which have already incorporates constructs other than overall measures of subjective well-being which are suitable for being outcome variables. For example, self-esteem has been found to be consistently associated with QOL (e.g., Lyubomirsky et al. 2006; Wu et al. 2009c), but it has been included in the psychological health domain in the WHOQOL-BREF scale. If we use self-esteem as an outcome variable in this study, the problem of criterion contamination will occur and a bias finding resulting from that problem will prevent us to make a solid conclusion. As such, we rely on the three overall measures of subjective well-being to evaluate the performance of importance weighting.

2 Method

2.1 Participants

One hundred and forty-six undergraduate students from two universities in Taiwan and China participated in this study. The sample consisted of 47.9 % male (n = 70) and 52.1 % female (n = 76) respondents. The mean age was 20.25 years (standard deviation = 1.14, ranging from 17 to 26). Volunteers completed the questionnaires at the end of a class. We assured all participants that their confidentiality and anonymity would be maintained. Participants completed the questionnaires in approximately 20 min and returned the form directly to one of authors.

2.2 Instruments

2.2.1 The WHOQOL-BREF and Importance Rating Questionnaires

Two measurements from the WHOQOL instrument (The WHOQOL Group 1998) were used. The first one is the WHOQOL-BREF version, which was developed from the WHOQOL-100 version and contains four domains related to QOL (physical health, psychological health, social relationships, and environmental health), as well as one facet measuring overall QOL and general health. The WHOQOL-BREF version has 26 standard items, including one item for overall QOL, one item for general health, seven facets for physical health, six facets for psychological health, three facets for social relationships, and eight facets for environmental health. A five-point scale was used for all items but with different response scales (i.e., capacity, evaluation, frequency, and intensity), depending on the content of the questions. In addition to the WHOQOL-BREF, the WHOQOL instrument also incorporates a questionnaire for importance ratings of various facets in the WHOQOL-100 version, using a five-point scale ranging from 1 (not important) to 5 (extremely important). Our participants were asked to complete both measurements. The WHOQOL instrument has been validated and used in various countries, and the validity of the WHOQOL-BREF Chinese and Taiwan version has been supported (Yao et al. 2002; Yao and Wu 2009). In the current study, we used the two items for overall QOL and general health as outcome variables. With the purpose of evaluating the effect of importance weighing, we used seven facets for physical health, five facets for psychological health, three facets for social relationships, and seven facets for environmental health because they matched the content of items in the importance rating questionnaire. Each facet is displayed in Table 1.

2.2.2 The Satisfaction with Life Scale

The Satisfaction with Life Scale (SWLS) was developed by Diener et al. (1985). It contains five items and employs a seven-point Likert-type scale with higher values corresponding to a higher degree of satisfaction. The SWLS has shown good reliability and validity (see Pavot and Diener 1993, 2008). We used the version translated by Wu and Yao (2006a). This version has revealed the single-factor structure, factor invariance across gender, and factor invariance across time (Wu et al. 2009b; Wu and Yao 2006a) and has been used in many studies (e.g., Wu and Yao 2006b, c, 2007a). The internal consistency (coefficient α) of the scale in the current sample was .87.

Table 1 Descriptive statistics of facets

Facets	Raw score		Importance		Weighted score	
	M	SD	M	SD	M	SD
Physical health						
Pain	3.52	.84	3.89	.96	10.01	3.95
Medication	4.50	.69	4.24	1.00	14.55	5.02
Energy	3.08	.80	4.28	.73	10.14	3.61
Mobility	3.79	.86	3.33	1.10	9.03	5.10
Sleep	3.31	1.02	4.57	.54	11.82	4.21
Activities	3.34	.79	3.87	.85	9.54	3.65
Work	3.10	.84	4.29	.75	10.14	3.65
Cronbach's α for raw score = .65						
Cronbach's α for weighted score = .65						
Psychological health						
Positive feeling	3.04	.81	4.57	.61	10.95	3.65
Thinking	2.98	.91	4.32	.73	9.91	3.86
Body image	3.34	.80	3.64	.89	8.88	3.80
Self-esteem	3.25	.88	4.31	.73	10.90	4.10
Negative feeling	3.12	.78	3.79	.83	8.70	3.30
Cronbach's α for raw score = .75						
Cronbach's α for weighted score = .71						
Social relationships						
Relations	3.13	.92	4.39	.65	10.66	4.00
Sex	3.08	1.00	3.20	1.14	6.64	4.32
Social support	3.60	.72	4.22	.74	11.66	3.82
Cronbach's α for raw score = .54						
Cronbach's α for weighted score = .54						
Environmental health						
Safety	3.48	.82	4.06	.82	10.66	3.96
Environment	2.90	.90	3.53	.84	7.40	3.52
Finance	3.08	.96	4.12	.80	9.45	3.63
Information	3.22	.94	4.10	.82	9.95	3.99
Leisure	3.06	.84	4.27	.73	10.11	3.82
Home	3.18	.88	4.27	.83	10.41	3.89
Transportation	2.66	1.05	3.79	.87	7.30	3.61
Cronbach's α for raw score = .70						
Cronbach's α for weighted score = .74						
Overall subjective well-being						
Overall QOL	3.08	.66				
General health	3.20	.88				
Life satisfaction	4.09	1.15				

2.3 Weighting Scheme

We used the following formula to derive the importance-weighted score for a given facet, i.

$$\text{Weighted score}_i = \text{Raw score}_i \times (\text{Importance score}_i - 1)$$

The raw score of a facet is the original response (from 1 to 5) in the WHOQOL-BREF. The importance score is the response (from 1 to 5) to a facet in the importance rating questionnaire. After subtracting 1 point from the importance score, the weighted values ranged from 0 to 4, which means that facets rated as "not important" have a zero score on the weighted score, providing a neutral point for the weighted score. This weighting scheme is concerned with the linear effect of the importance score on the weighted score (Hsieh 2003). We did not include other weighting schemes because past studies have shown that different weighting schemes have the same or similar performance in predicting outcome variables (Hsieh 2003; Wu and Yao 2006c). Moreover, a linear effect on the importance score is common among the existing weighting schemes in QOL research (Wu and Yao 2006c).

3 Results

Table 1 presents means and standard deviations of facets with respect to the raw evaluation scores, importance ratings, and importance-weighted scores and of the three overall subjective well-being indices.

Table 2 presents correlations between the three overall subjective well-being indices and the raw or weighted scores. In addition to each facet, we also created a summary score for each domain (i.e., physical health, psychological health, social relationships, and environmental health) by averaging the facet scores under each domain for both raw and weighted scores.

In general, the results showed that in most cases, correlations between the three overall subjective well-being indices and the raw scores were higher than or similar to the correlations between the three overall subjective well-being indices and the weighted scores. Only a few cases produced the opposite effect.

Table 3 presents the results of regression analysis with standardized regression coefficients in predicting the three overall subjective well-being indices using the four summary domain scores with raw scores or weighted scores, respectively.

We found that the summary score of psychological health based on raw scores positively predicted the three overall subjective well-being indices ($ps < .01$). The summary score of environmental health based on raw scores or weighted scores positively predicted overall QOL and life satisfaction ($ps < .01$). The summary score of physical health based on raw scores or weighted scores positively predicted general health ($ps < .01$). Social relationships only predicted general health ($p < .05$) when using a summary score based on weighted scores.

However, based on the standardized coefficients, the predictive effects of the summary score based on raw scores were stronger than the predictive effects of the summary score based on weighted scores. Moreover, we also found that the four summary scores based on raw scores explained more variances in the three overall subjective well-being indices than the four summary scores based on weighted scores did. Our findings are inconsistent with the expected predictive benefits of importance weighting.

Table 2 Correlations between the three overall subjective well-being indices and the raw or weighted QOL scores

	Overall QOL		General health		Life satisfaction	
	Raw score	Weighted score	Raw score	Weighted score	Raw score	Weighted score
Physical health						
Pain	.05	−.08	.02	−.07	.05	.01
Medication	.06	.04	.28**	.18*	.07	.11
Energy	.22**	.18*	.40**	.37**	.28**	.25**
Mobility	.13	.00	.26**	.10	.18*	.07
Sleep	.24**	.21**	.39**	.41**	.30**	.24**
Activities	.33**	.25**	.35**	.21*	.34**	.29**
Work	.40**	.28**	.23**	.36**	.38**	.36**
Summary score	.36**	.20*	.49**	.38**	.41**	.32**
Psychological health						
Positive feeling	.43**	.33**	.26**	.17*	.37**	.25**
Thinking	.22**	.26**	.38**	.36**	.26**	.26**
Body image	.33**	.15	.25**	.15	.33**	.19*
Self-esteem	.42**	.36**	.33**	.30**	.48**	.45**
Negative feeling	.44**	.24**	.38**	.23**	.46**	.26**
Summary score	.51**	.40**	.45**	.36**	.53**	.42**
Social relationships						
Relations	.43**	.38**	.17*	.21*	.41**	.41**
Sex	.14	.17*	.19*	.29**	.15	.18*
Social support	.30**	.33**	.31**	.34**	.37**	.40**
Summary score	.39**	.40**	.30**	.39**	.42**	.45**
Environmental health						
Safety	.46**	.40**	.36**	.35**	.40**	.33**
Environment	.21*	.19*	.20*	.11	.45**	.39**
Finance	.13	.22**	.25**	.24**	.18*	.23**
Information	.19*	.24**	.11	.23**	.28**	.30**
Leisure	.39**	.35**	.24**	.17*	.39**	.37**
Home	.22**	.21**	.23**	.23**	.39**	.36**
Transportation	.14	.17*	−.12	−.01	.24**	.28**
Summary score	.41**	.41**	.29**	.31**	.55**	.52**

* $p < .05$; ** $p < .01$

4 Discussion

This study contributes to the literature that examines the effectiveness of importance weighting in predicting outcome variables in a multidimensional measurement context. Inconsistent with the idea of importance weighting, we found that multidimensional importance-weighted scores did not account for more variances of overall QOL, general health, and life satisfaction. Moreover, we also found that the predictive pattern is less sharp using multidimensional importance-weighted scores. Thus, we suggest that

Table 3 Results of regression analysis with standardized coefficients

	Overall QOL		General health		Life satisfaction	
	Raw score	Weighted score	Raw score	Weighted score	Raw score	Weighted score
Physical health	−.02	−.18	.34**	.22*	−.04	−.07
Psychological health	.39**	.24*	.27**	.13	.37**	.15
Social relationships	.06	.18	−.02	.23*	.04	.16
Environmental health	.23**	.28**	.00	−.04	.40**	.38**
F test	16.02**	11.28**	13.73**	9.08**	25.35**	15.71**
R2	.31	.24	.28	.21	.42	.31

* $p < .05$; ** $p < .01$

importance weighting did not have its expected benefits but instead may negatively impact the predictive effects.

Our negative finding directly relates to the question whether importance weighting is necessary or not. Our current finding suggests that importance weighting is not necessary as it cannot account for more variances of overall measures of subjective well-being. This suggestion is in line with past findings in evaluating the predictive effect of importance weighting in other contexts (e.g., Hsieh 2003; Russell et al. 2006; Wu and Yao 2006b, c) and findings in a series of studies based on Locke's range-of-affect hypothesis (Wu 2008b; Wu and Yao 2006b, 2007b), which question the psychological basis for importance weighting. Although Hsieh (2011, 2012a, b) recently provided several reasons to support the importance of importance weighting in QOL research, theoretical guidance for how to weight is still lacking. In supporting of the usage of importance weighting, not only should the utility (i.e., having a better predictive effect) of importance weighting be consistently observed across contexts and samples, but also the theoretical reason for why a certain weighting algorithm is applied should be provided. Findings on importance weighting so far in the literature seem not to support these two requirements.

Nevertheless, as aforementioned, performance of importance weighting was usually evaluated in specific contexts without considering the multidimensional measurement context. As such, more evidence from different research contexts is required to have a comprehensive evaluation on the benefit of importance weighting. For example, although we have considered a multidimensional measurement in this study, we only examined performance of importance weighting at between-individual level, rather than at within-individual level. As indicated by Wu (2008b), importance weighting is a procedure using an individual's scores across different domains in a within-individual context, evaluating its performance at within-individual level would be more desirable to see whether the weighting procedure can help to capture idiosyncratic meaning of an individual's QOL. Future studies can extend our research to a within-individual examination.

In addition to the importance weighting literature, our findings, especially the results of unweighted scores, also provide some implications for QOL in the population of university students. First, we found that psychological health is overwhelmingly important to university students for better subjective well-being. This finding is in line with past findings in subjective well-being literature, especially because psychological health includes facets of positive feelings, negative feelings, and self-esteem. These three facets have been found to

be important determinants of subjective well-being (i.e., self-esteem) (e.g., Schimmack and Diener 2003) or even part of subjective well-being (i.e., positive feelings and negative feelings) (Pavot and Diener 1993, 2008).

Second, we found that physical health, in addition to psychological health, positively predicted general health. This finding suggests that the idea of health in university students is more about their internal feelings regarding their physical and psychological states than about their external conditions, such as relationships with others or their broader physical environments. In contrast to this finding, environmental health, in addition to psychological health, positively predicted QOL and life satisfaction, suggesting that the idea of QOL and life satisfaction in university students is more related to external conditions with respect to their broader physical environments.

Nevertheless, the predictive effect of social relationships is weak. Only the importance-weighted score of social relationships has a significant effect on predicting general health. Its unweighted score did not have any significant predictive effect. This finding is inconsistent with the notion that Chinese people tend to emphasize social relationships (Yao and Wu 2009) and therefore that social relationships should have a stronger predictive effect on subjective well-being. This null finding has three potential reasons: The first reason is we only have three facets in the social relationships and only two of them directly reflect the quality of social relationship (i.e., relations and social support), whereas the other one is about sexual life, which is not related to general relationships with others. Hence, considering the content breadth of social relationships, social relationships may not have a stronger predictive effect on overall subjective well-being in our study because we included more facets in the other three domains and hence enhanced their predictive effects.

The second reason is that the impact of social relationships on overall subjective well-being may be mediated by psychological health, and thus, when they are put together to predict overall subjective well-being, the impact of social relationships will be diminished. For example, self-determination theory proposes that better social relationships can contribute to positive feelings due to need fulfillment (Deci and Ryan 2000; Deci and Vansteenkiste 2004). Sociometer theory (Leary 1999) proposes that self-esteem is determined by the quality of social relationships in terms of others' likings. Mapping these concepts to our current measurements, these two theories suggest that the quality of social relationships is an antecedent of psychological health (e.g., positive feeling and self-esteem), and therefore, when predicting overall subjective well-being, the impact of social relationships will be mediated by psychological health. Supporting this view, in a supplementary analysis, we found that social relationships can positively predict the three indices of overall subjective well-being, but this positive effect disappeared when psychological health was included as a predictor. This supplementary finding therefore suggests more complex relationships among constructs in a multidimensional QOL structure.

The third reason is that we did not include key facets in assessing social relationships in Chinese culture. In scale development, the WHOQOL instrument not only provides standard items for all countries, but also encourages each country or area to include additional facets that can reflect important cultural features in determining QOL. In Yao and Wu's (2009) article, they reviewed three Chinese versions of the WHOQOL instrument from China, Hong Kong, and Taiwan and found that Hong Kong and Taiwan versions included the same facet reflecting the indigenous meaning of social relationships (i.e., being respected and accepted/Guanxi/Mientze) in Chinese culture. It is possible that because we only used standard items in the WHOQOL-BREF version and did not include

national items with respect to being respected and accepted/Guanxi/Mientze, we did not find a significant effect of social relationships on overall subjective well-being.

In addition to the aforementioned implications, limitations of this study should also be acknowledged. First, Cronbach's α (alpha) of physical health and social relationship is relatively lower because facets of pain, medication, and sex are not ideal for university students to evaluate their QOL; most of them did not have serious problems with pain, did not rely on medication, and did not have much sexual experience, and they are usually confused when responding to the item for sex. However, when these facets are removed, we still obtain the same pattern and conclusion about the performance of importance weighting. Including these facets did not distort our conclusion. Nevertheless, future studies are encouraged to use different measurements to cross-validate our findings. Second, we only used university students here as a convenient sample to test the performance of importance weighting. Although the procedure of importance weighting is sample-free, it is still desirable to see if the same finding can be obtained when it is applied to different populations. Third, this is a cross-sectional study. We only used the term of "predictive effect" to mention the statistical relationship between predictors and outcomes in regression analyses. As such, it should be noted that our study cannot provide causal inference.

In sum, our study suggests that importance weighting in a multidimensional context cannot have its expected benefit but may hurt the predictive effect. Future studies are needed to cross-validate our findings with different measurements and samples.

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